NSDI Framework Data Services

Usability Guidelines, Version 1.0

Standards-Based Geospatial Data Services Provided By:

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What is the NSDI Framework Data Service?

The National Spatial Data Infrastructure (NSDI) Framework Data Service is an online service located at http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi that provides web-based access for high volumes of Framework data at multiple resolutions. The service is optimized for online delivery of Hydrography, Transportation & Governmental Units Framework Data Themes and is based on OGC Web Feature Server (WFS), Filter Encoding (FE), Geography Mark-Up Language Simple Features (GMLsf) standards. The service implements ANSI Framework standards to simplify exchange of data among all users.

The NSDI Framework Data Service offers a powerful way to access Hydrography, Roads and Governmental Units information, and combine it with other data in your client application. Please note that the NSDI Framework Data Services are optimized for online delivery through the implementation of Web Map Server (WMS) aggregate views. Multiple resolutions of the data themes are available and you need to make sure you use suitable WFS client application to access it.

Why provide an NSDI Framework Data Service?

The FGDC and USGS are working to serve society's needs for geospatial information by evolving their data services to implement Spatial Data Infrastructures (SDIs) based on OGC and ANSI Framework Data standards and position them to support evolving application clients and tools. The NSDI Framework Data Service takes yet another step towards efficient online eGovernment by making Framework data available for computer to computer transfer and processing. Public agencies and private enterprises can then use this data in their geospatial application clients and tools. Once imported into the applications, data can be displayed, integrated with other data sets, and used to help create products to enhance the value of Framework data.

How should I approach the use of the NSDI Framework Data Service?

An understanding of OGC Web Services Standards is essential to effective utilization of the NSDI Framework Data Service. Unlike a GIS environment exposing geographic features for a specific and narrowly defined project, a data service such as the NSDI Framework Data Service, exposes seamless geographic features covering very large geographic areas, and its volume can easily reach multi-terabytes in size. In order to efficiently operate on such on-line data services, the following guidelines are recommended:

1. Use WMS to navigate & explore any potentially large data store.

2. Utilize WMS to define a limited geographic extent and/or other 'filters' to limit needed WFS feature set.
3. Invoke WFS to operate on actual features for attribute query, download and/or transactions as required.

As a general rule WFS queries and requests should be limited to those features which the user needs to either download to use locally, or those features which the user intends to perform individual attribute queries and/or interactive transactions against. Therefore, using a WMS service to navigate into the potentially large volume WFS data store is a good general rule. To support this workflow, a WMS version of the NSDI Framework Data Services has also been deployed. In addition to navigating with WMS, the OGC Filter Encoding Specification provides additional ways to limit query sets beyond geographic extent. Some clients, such as The Carbon Project's Free Geospatial Web Browser-Gaia or its' ArcGIS Extension-CarbonArc, implement support for this standard and can be used to limit queries using Boolean Operators, Maximum Number of Features and/or Geographic Extent.

Once the needed features set is defined geographically and by any limiting attribute requirements, the WFS can be invoked and the NSDI Framework Data Service will return to the client the requested set of features. The efficiency of the overall operation will be determined by your ability to use the filtering mechanisms available from the NSDI Framework Data Service, and will therefore, also depend on the selection of client tools used to access the NSDI Framework Data Service. It is possible that some users will want large feature sets for local analytical purposes. While the NSDI Framework Data Service will service requests for very large sets of features, currently the service is configured to truncate the WFS Request Response at a 50MB threshold. This threshold may be adjusted on an ongoing basis or enhanced with predictive feedback estimating the download time for large queries. Finally, in order to maintain currency and consistency with the source data, WFS Transactions against the NSDI Framework Data Service are limited to the USGS.

How Do You Use the NSDI Web Feature Service?

The user must select a client application which supports WFS 1.1.0. Please note that each client application has its own procedures for retrieving data from a WFS. The following steps provide some of the actions that a client application may or may not take care of without user knowledge or input.

a. If required, the client application sends a GetCapabilities request to the service endpoint. The following URL provides a sample GetCapabilities request and returns the service capabilities document.

GetCapabilities Request
http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi?SERVICE=WFS&Request=GetCapabilities&VERSION=1.1.0

If required, the client application will then likely send a DescribeFeatureType request.

b. The client application sends a GetFeature request to which the server responds with a GMLsf document. Sample requests to return Road Segments and Hydrography Flow Lines near Washington, DC include:
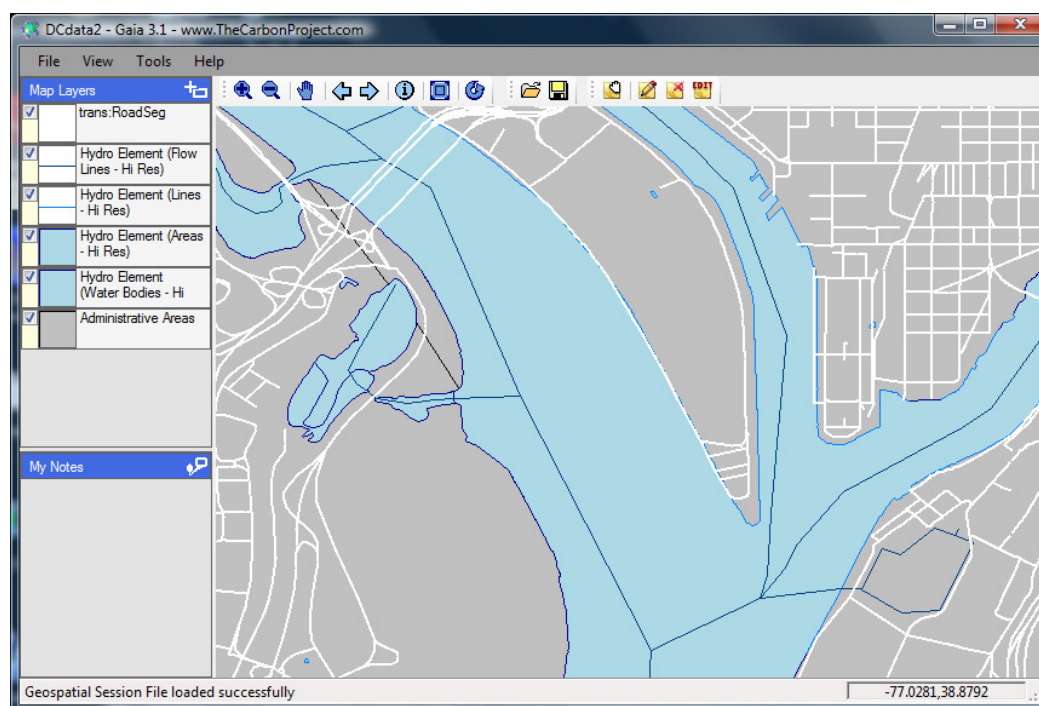
Road Segments
http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi?SERVICE=WF&Request=GetF
eature&VERSION=1.1.0&BBOX=77.0502133366756,38.8486715052405,-
77.0067638016515,38.8795394303025&TYPENAME=trans:RoadSeg

Hydrography Flow Lines
http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi?SERVICE=WFS&Request=Get
Feature&VERSION=1.1.0&BBOX=-77.0502133366756,38.8486715052405,-
77.0067638016515,38.8795394303025&TYPENAME=hyd:HydroElementFLHI

c. The client application parses the GML and makes its contents available for display. (Please note that a high speed internet connection is recommended.)

NSDI Framework Data, including Road Segments and Hydrography displayed in the free Gaia 3.1 geospatial viewer application.

How is NSDI GML generated?

When a user requires Framework data, a geospatial application can create and send a GetFeature request to the NSDI WFS. The client's request is processed, creating the GMLsf data which is returned to the requesting application for processing. The figure below provides a graphical view of the process.
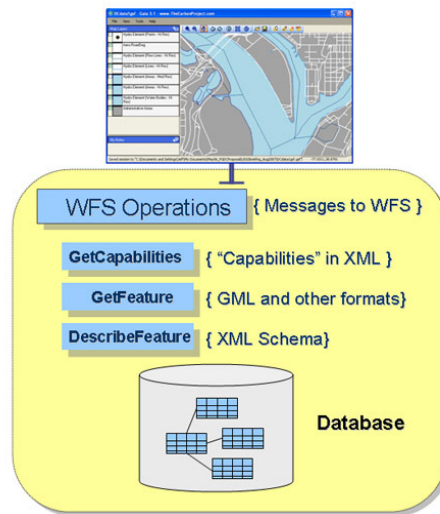
NSDI Framework Data Service Architecture

How do I access the NSDI Framework Data Services in Gaia?

Gaia from The Carbon Project (www.TheCarbonProject.com) is an open-geospatial viewer developed with the support of the NSDI CAP. This viewer can access an array of geospatial sources such as the *Open Geospatial Consortium* (OGC) Web Mapping Service (WMS), Web Coverage Service (WCS), and Web Feature Service (WFS), commercial services such as *Microsoft Virtual Earth*, and *Yahoo! Maps* as well as file formats such as *ESRI* Shapefiles, *Google Earth* KML/KMZ, DXF, MIF and Geography Markup Language (GML).

With Gaia you can use geospatial content from different sources and overlay them into a single map view, with each layer individually configured and styled. The Gaia multi-layer view allows seamless use of multiple layers of different types. Panning, zooming and other mapping tools provide a fast and convenient tool for browsing the map. Gaia uses dynamic caching of content to memory, providing enhanced mapping performance.
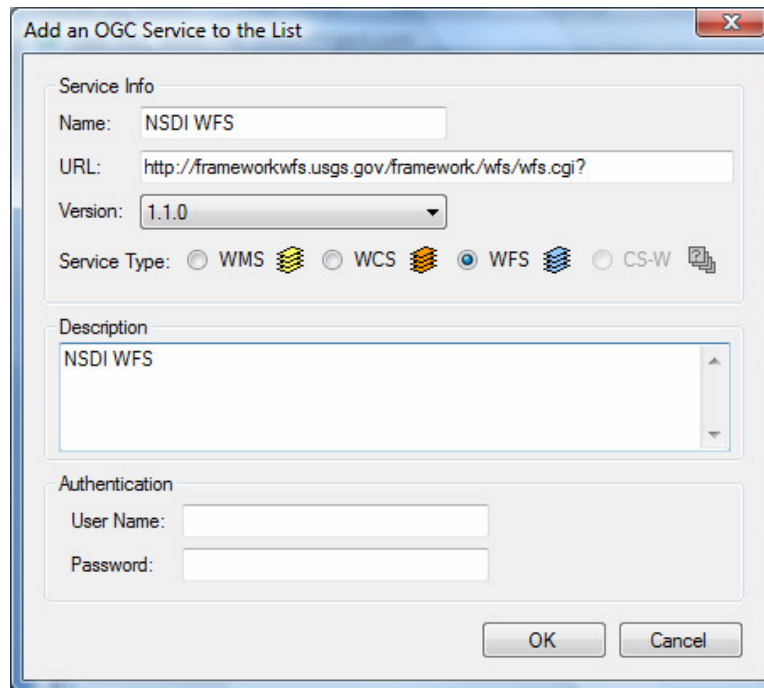
To use Gaia with the NSDI WFS simply download and install the application from this website http://www.thecarbonproject.com/gaia.php. Detailed instructions are available in the Gaia User's Guide located at http://www.thecarbonproject.com/pdfs/Gaia3_UserGuide.pdf.

Once Gaia is installed, you can start using the NSDI WFS by opening the application. You'll see the start screen shown below.
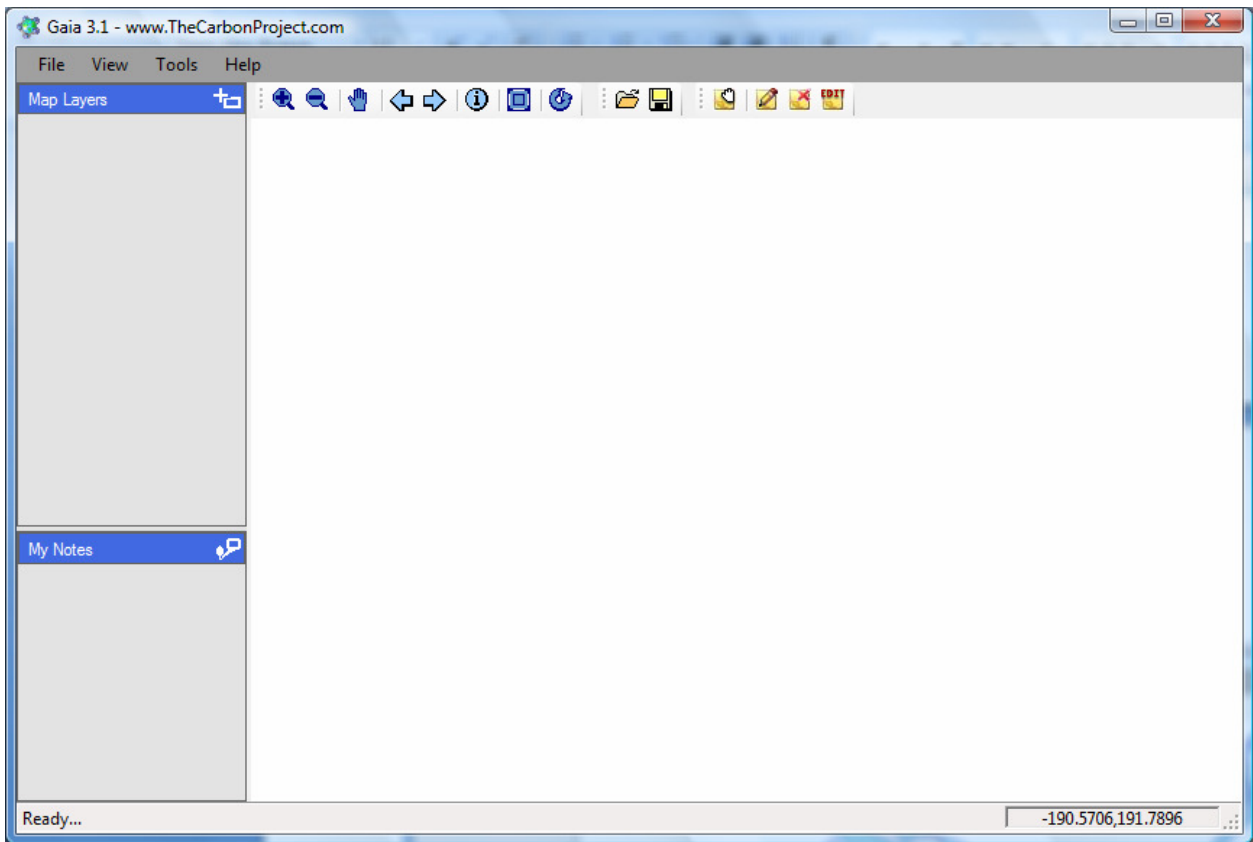
Before the NSDI WFS is usable you must add the service to the list of *OGC Services* accessible by Gaia. The layers added to the map view are managed in the *Map Layers* panel. To add the

NSDI WFS to the application click the in the *Map Layers* panel. The *Add an OGC Servicesto the List* dialog box will appear -
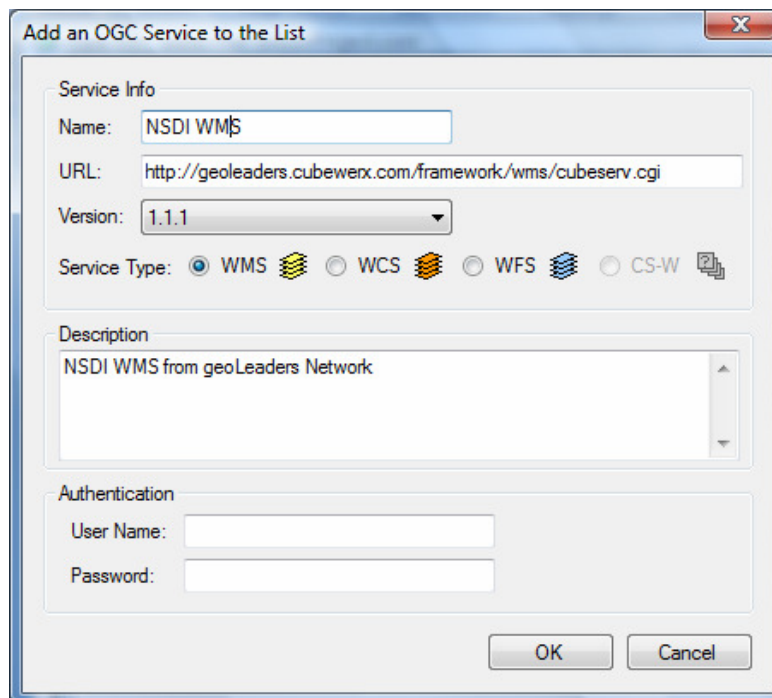
It's also recommended that you add the NSDI WMS to the application using the same tool -
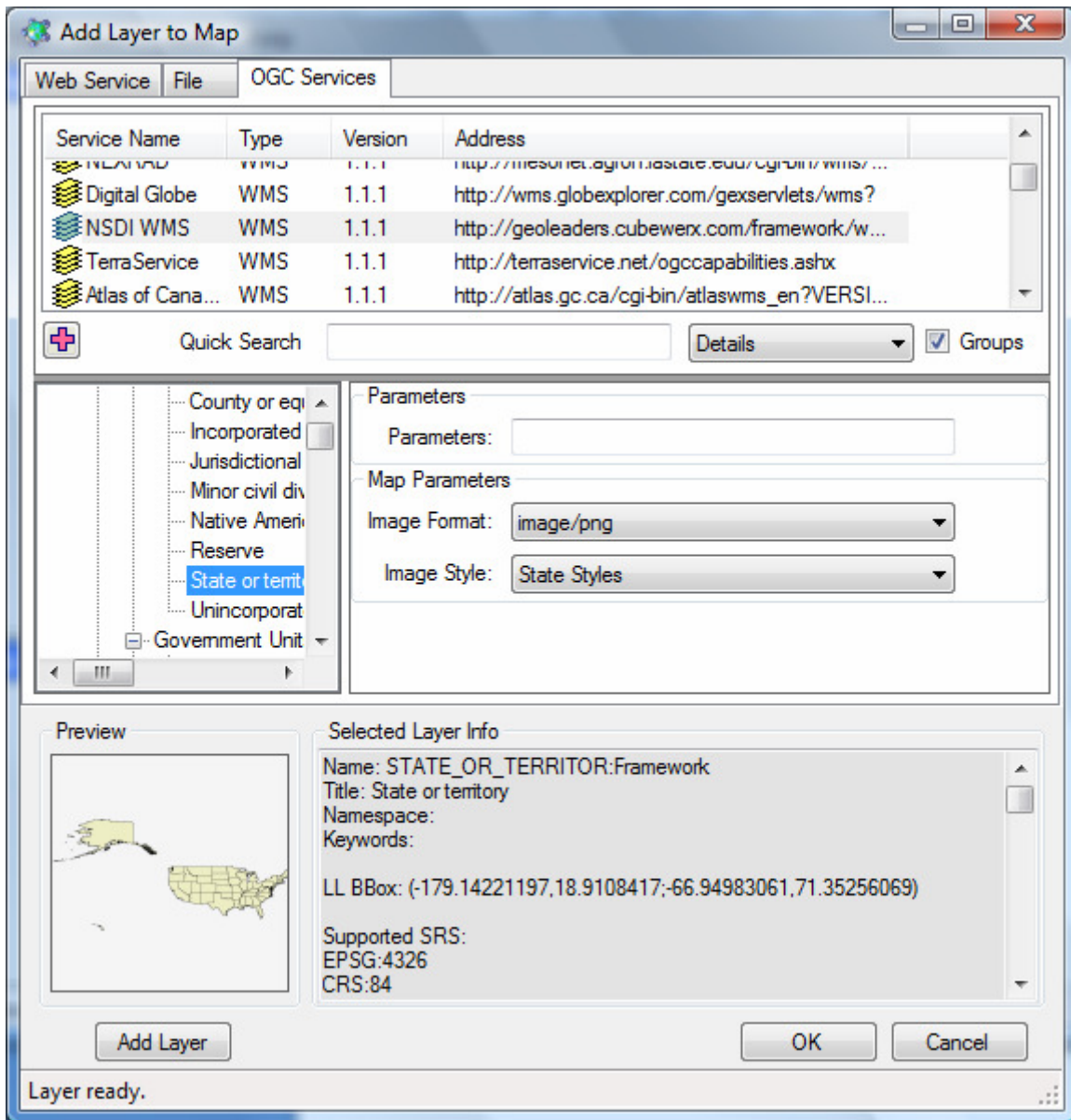

Once the NSDI WFS and a reference WMS are added to the application you can begin to add layers as shown below -

When you click 'Add Layer' and the data will be added to Gaia. To begin using the NSDI WFS zoom into the area you are interested in and add additional WFS layers by clicking the 'Add Layer' tool located at the top of the *Map Layers* panel (alternatively you can use CTRL+A after you zoom in). To add layers from the NSDI WFS, select OGC Services and pick the NSDI WFS layer you want from the 'Add Layer to Map' tool. In the example below the Hydro Element Points from the NSDI WFS are selected -
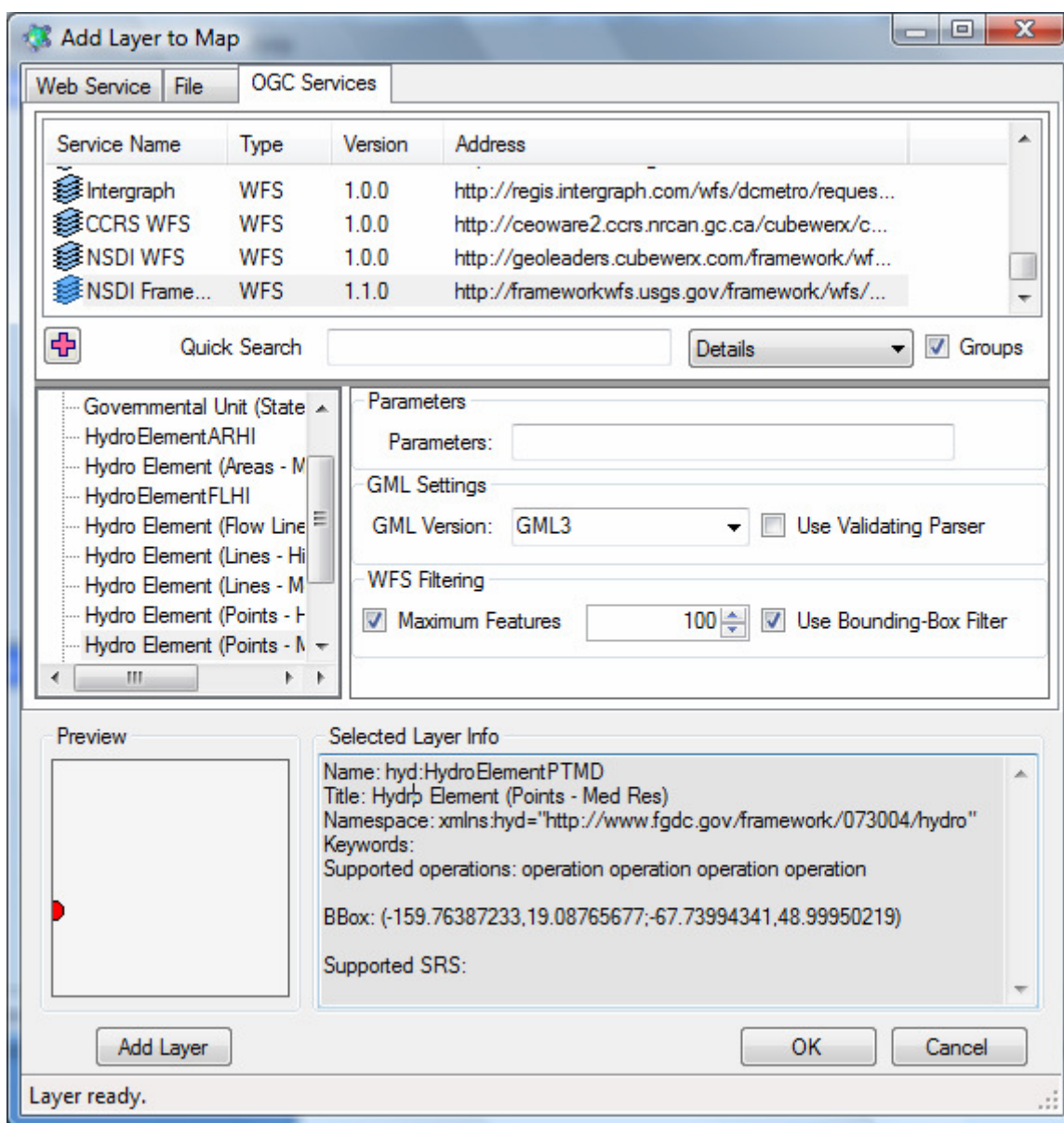
IMPORTANT NOTE - Make sure you set the *Maximum Features* and *Use Bounding-Box Filter*. Please also note that the 'Add Layer to Map' tool will not provide the capability to select the Bounding Box Filter until the selected layer has completely loaded in the Preview window.

In the examples below several layers are shown –

- State boundaries from a WMS based on the NSDI Framework Data Service
- Hydro Element Points from the NSDI WFS
- Hydro Element (Areas – Medium Resolution) from the NSDI WFS
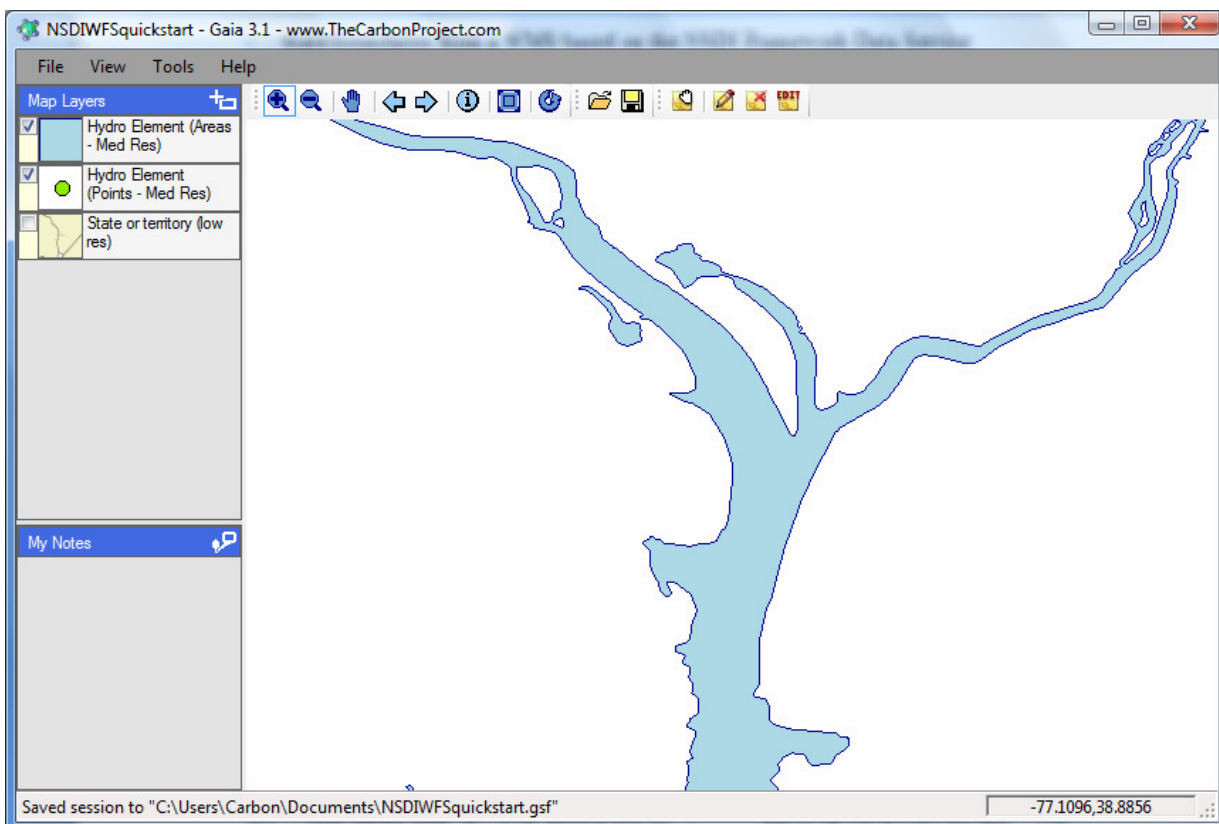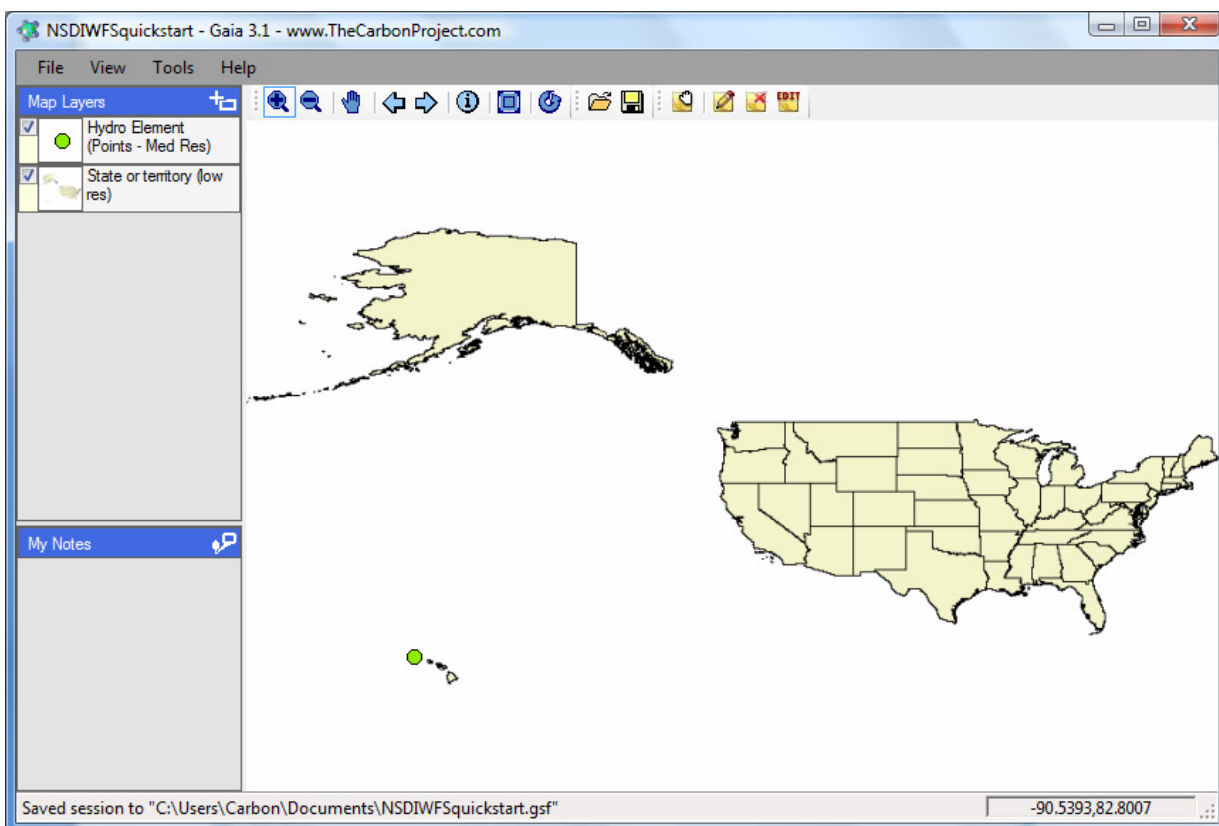
You can add and style additional WMS and WFS to create the application you need.

How do I access the NSDI Framework Data Services in ArcGIS?

ArcGIS is the most broadly used GIS Desktop Clients. Users of ArcGIS can either use the native support provided within ArcGIS, or utilize an extension such as CarbonArc PRO for ArcGIS from The Carbon Project. For additional information please visit www.esri.com and/or www.thecarbonproject.com .
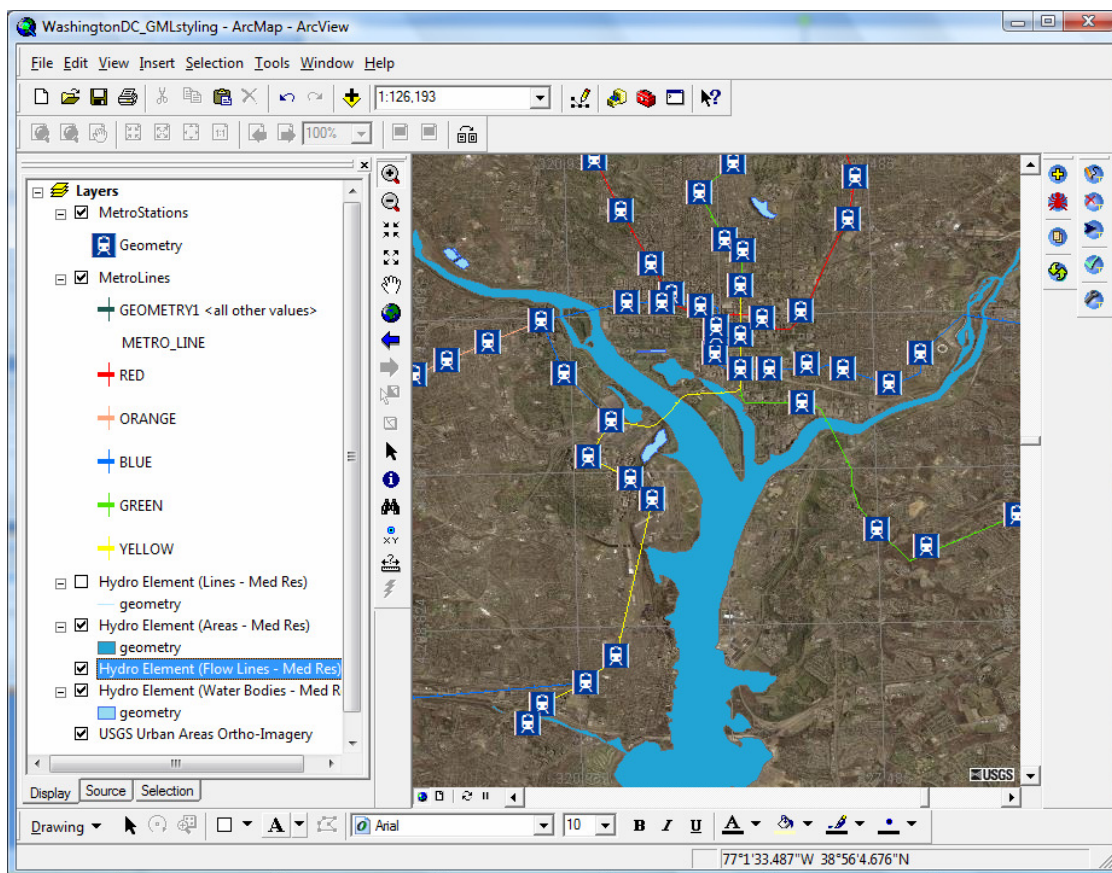
Hydrography data from the NSDI Framework Service and other data displayed in ArcGIS using CarbonArc PRO
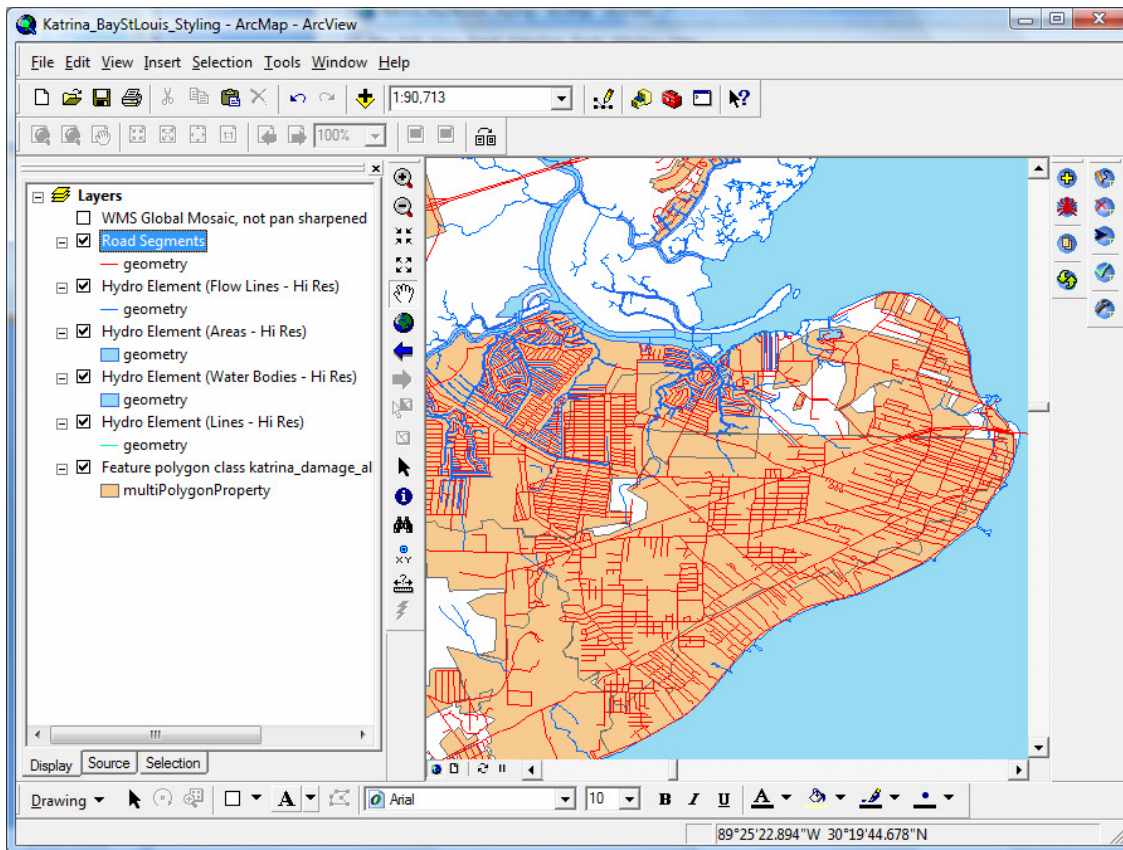
Road Segments and Hydrography data from the NSDI Framework Service displayed in ArcGIS using CarbonArc PRO
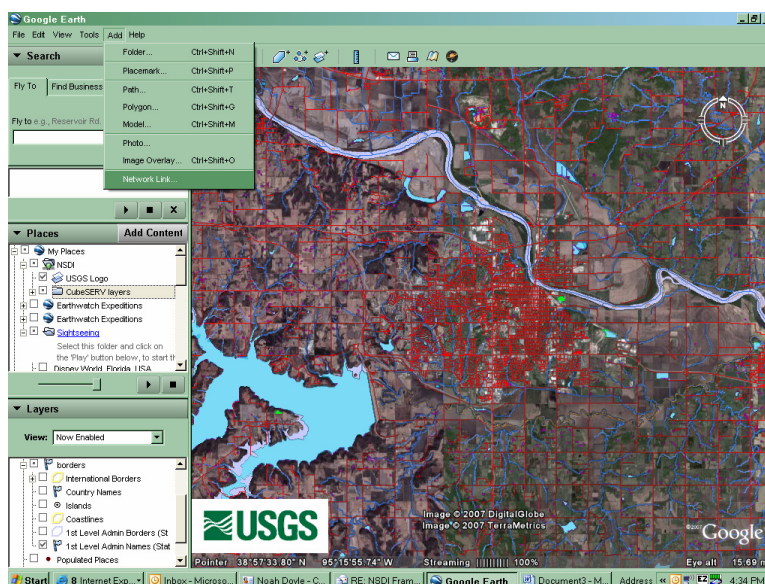
How do I access the NSDI Framework Data Services in Google Earth?

It is easy for a user of Google Earth to access NSDI Framework Data, but only in WMS form, by simply requesting the capabilities of the service using an additional parameter: FORMAT=KML. This will query the capabilities of the NSDI Framework Data Service WMS and automatically produce a KML "tree view" layer selection interface in Google Earth, complete with themes and selectable styles for individual map layers. The response sent back from the NSDI Framework Data Service WMS provided by geoLeaders will contain the appropriate content and MIME type to start Google Earth with the tree view interface that is displayed within Google Earth application.

The NSDI Framework Data Service leverages KML's feature allowing the definition of Network Links that point to dynamic remote data sources. The NSDI Framework Data Service interface for Google Earth transparently creates the appropriate Network Links in Google Earth to enable access to the WMS layers published in the capabilities document. The NSDI Framework Data Service can also be used to provide Google Earth access to any map server that supports the OGC Web Map Server interface through its' Cascading WMS capability.

The following URL will launch and load the NSDI Framework Data Service WMS, but requires that Google Earth has been installed. Google Earth is available for download from http://earth.google.com/download-earth.html.

http://geoleaders.cubewerx.com/framework/wms/cubeserv.cgi?SERVICE=wms&VERSION=1.3.2
&REQUEST=GetCapabilities&XSLT=http://geoleaders.cubewerx.com/framework/kml/wms_1.3.2
ToKMLStyles.xsl&XSLT_MIME=application/vnd.google-earth.kml%2bxml

NSDI Framework Data displayed in Google Earth using WMS/KML

How do I discuss issues relating to the NSDI Framework Data Service?

There is an unofficial NSDI Web Feature Service user forum that might be able to help
developers with issues. The unofficial forum can be found at the following URL:

http://www.thecarbonportal.net

The Forum is located under "Main Menu – Forum". Access is free; all you need to do is set up an
account.

Reference URLs

SERVICE ACCESS
WFS Services: http://frameworkwfs.usgs.gov/framework/wfs/wfs.cgi?
WMS Services: http://geoleaders.cubewerx.com/framework/wms/cubeserv.cgi

DOCUMENTATION
Usability Guidelines: http://geoleaders.com/NSDIFrameworkServices_Usability.pdf

Project Briefing:	http://geoleaders.com/USGSFrameworkWFS_Aug07final.ppt
ANSI Framework Schemas:	http://geoleaders.cubewerx.com/framework/schemas/gmlsf1
ANSI Documentation	http://geoleaders.cubewerx.com/framework/docs/ansi
UML Models	http://geoleaders.cubewerx.com/framework/uml

FREE CLIENTS & UTILITIES

Gaia Geospatial Web Browser:	http://www.thecarbonproject.com/gaia.php
CubeWerx CubeXPLOR Client:	http://geoleaders.cubewerx.com/framework/wms/cubexplor.cgi
Google Earth:	http://earth.google.com/download-earth.html
CURL:	http://curl.haxx.se/

STANDARDS & SPECIFICATIONS

FGDC Framework Data Content Standards:	http://www.fgdc.gov/ - Link
WFS Specification	http://portal.opengeospatial.org/files/?artifact_id=8339
GML Simple Feature Specification:	http://portal.opengeospatial.org/files/?artifact_id=15201
Filter Encoding Specification:	http://portal.opengeospatial.org/files/?artifact_id=8340